WHAT IS CLAIMED IS:

1. A disc storage system having a servo loop for positioning a head over a disc, the servo loop comprising:

a voice coil motor actuator configured to move the head in response to a received servo control signal;

a sensor, located in the head, which is configured to sense servo information located on the disc and produce a servo signal therefrom, the servo signal is combined with a reference signal to produce a position error signal;

a servo controller configured to receive the position error signal and to responsively produce the servo control signal, the servo controller comprising:

a drive signal generator configured to receive the position error signal and to responsively produce a driving energy signal; and

a vibration damping circuit configured to receive the driving energy signal and to responsively produce the servo control signal; and

a real-time adaptive loop shaping circuit configured to detect vibration energy in the position error signal and to responsively adjust at least one parameter of a transfer function of the vibration damping circuit to reduce vibrations at different frequencies in the driving energy signal.

2. The apparatus of claim 1 wherein the vibration damping circuit includes a notch filter to damp vibrations at high frequency resonance modes, and wherein the real-time adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to responsively adjust a depth of the notch filter.

3. The apparatus of claim 2 wherein the real-time adaptive loop shaping circuit adjusts the depth of the notch filter by modifying a gain of the notch filter.

4. The apparatus of claim 2 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect vibrations at high frequency resonance modes in the position error signal.

5. The apparatus of claim 1 wherein the vibration damping circuit includes a non-repeatable runout compensator to cancel non-repeatable runout disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect non-repeatable runout disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.

6. The apparatus of claim 5 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect non-repeatable runout disturbances in the position error signal.

7. The apparatus of claim 1 wherein the vibration damping circuit includes a rotational vibration compensator to cancel rotational vibration disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect rotational vibration disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.

8. The apparatus of claim 7 wherein the real-time adaptive loop shaping circuit includes a low-pass filter to detect rotational vibration disturbances in the position error signal.

9. The apparatus of claim 1 wherein the vibration damping circuit includes a plurality of disturbance adjustment compensators to cancel vibration disturbances at different frequency ranges, and wherein the real-time adaptive loop shaping circuit is configured to detect vibration disturbances at the different frequency ranges in the position error signal and to responsively adjust at least one parameter of a transfer function of at least one of the plurality of disturbance compensators.

10. The apparatus of claim 1 wherein the real-time adaptive loop shaping circuit includes a learning component that adjusts a speed of adaptation of the servo loop.

11. A method of maintaining stability in a servo loop used for positioning a head over a disc in a disc drive, the servo loop having a voice coil motor actuator and a servo controller that controls the voice coil motor actuator, the method comprising:

(a) generating a servo signal based on the position of the head over the disc;

(b) generating an actuator control signal for driving the voice coil motor actuator based on a position error signal, wherein the position error signal is determined by combining the servo signal with a reference signal;

(c) detecting vibration energy in the position error signal; and

(d) adjusting at least one parameter of a transfer function of the servo controller to attenuate the vibration energy detected in step (c) at different frequencies.

12. The method of claim 11 wherein the detecting vibration energy step (c) includes detecting vibrations at high frequency resonance modes, and wherein the adjusting step (c) includes adjusting a depth of a notch filter of the servo controller to reduce vibrations at high frequency resonance modes.

13. The method of claim 11 wherein the detecting vibration energy step (c) includes detecting non-repeatable runout disturbances, and wherein the adjusting step (c) includes adjusting at least one parameter of a transfer function of a non-repeatable runout compensator of the servo controller to reduce non-repeatable runout disturbances.

14. The method of claim 11 wherein the detecting vibration energy step (c) includes detecting rotational vibration disturbances, and wherein the adjusting step (c) includes adjusting at least one parameter of a transfer function of a rotational vibration compensator of the servo controller to reduce rotational vibration disturbances.

15. The method of claim 11 wherein the detecting vibration energy step (c) and the adjusting at least one parameter step (d) is carried out by a real-time adaptive loop shaping circuit.

16. A disc drive for storing information on a disc, the disc drive comprising:

a servo loop for positioning a head over the disc, the servo loop including a servo controller and a voice coil motor actuator, the voice coil motor actuator is configured to move the head in response to a servo control signal generated by the servo controller; and

a real-time adaptive loop shaping means for attenuating disturbances in the servo loop.

17. The apparatus of claim 16 wherein:

the servo loop further comprises:

a sensor, located in the head, which is configured to sense servo information located on the disc and produce a servo signal

therefrom, the servo signal is combined with a reference signal to produce a position error signal; and

the real-time adaptive loop shaping means comprises a real-time adaptive loop shaping circuit adapted to:

detect vibration energy in the position error signal and to responsively adjust at least one parameter of a transfer function of a vibration damping circuit of the servo controller to reduce vibrations at different frequencies in the servo loop.

18. The apparatus of claim 17 wherein the vibration damping circuit includes a notch filter to damp vibrations at high frequency resonance modes, and wherein the real-time adaptive loop shaping circuit is configured to detect vibrations at high frequency resonance modes in the position error signal and to responsively adjust a depth of the notch filter.

19. The apparatus of claim 18 wherein the real-time adaptive loop shaping circuit adjusts the depth of the notch filter by modifying a gain of the notch filter.

20. The apparatus of claim 18 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect vibrations at high frequency resonance modes in the position error signal.

21. The apparatus of claim 17 wherein the vibration damping circuit includes a non-repeatable runout compensator to cancel non-repeatable runout disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect non-repeatable runout disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.

22. The apparatus of claim 21 wherein the real-time adaptive loop shaping circuit includes a band-pass filter to detect non-repeatable runout disturbances in the position error signal.

23. The apparatus of claim 17 wherein the vibration damping circuit includes a rotational vibration compensator to cancel rotational vibration disturbances, and wherein the real-time adaptive loop shaping circuit is configured to detect rotational vibration disturbances in the position error signal and to responsively adjust at least one parameter of a transfer function of the non-repeatable runout compensator.

24. The apparatus of claim 23 wherein the real-time adaptive loop shaping circuit includes a low-pass filter to detect rotational vibration disturbances in the position error signal.

25. The apparatus of claim 17 wherein the vibration damping circuit includes a plurality of disturbance adjustment compensators to cancel vibration disturbances at different frequency ranges, and wherein the real-time adaptive loop shaping circuit is configured to detect vibration disturbances at the different frequency ranges in the position error signal and to responsively adjust at least one parameter of a transfer function of at least one of the plurality of disturbance compensators.

26. The apparatus of claim 17 wherein the real-time adaptive loop shaping circuit includes a learning component that adjusts a speed of adaptation of the servo loop.